International Journal of Zoology
and Research (IJZR)
ISSN(P): 2278-8816; ISSN(E): 2278-8824
Vol. 5, Issue 5, Oct 2015, 15-26

THE STANDS OF ANTS (HYMENOPTERA, FORMICIDAE) IN SOME FOREST AND AGRICULTURAL AREAS OF KABYLIA

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ABSTRACT

The study was conducted in three stations owned forest environments, and two stations owned agricultural environments in ecosystems of the remote province of Tizi-Ouzou, a hundred kilometers from the capital. Use barber pots on a transect allowed the harvest of 19,116 individuals belonging to 15 species and 3 subfamilies (Myrmicinae, Formicinae and Dolichoderinae). The relative abundance of species shows a preponderance of *Crematogaster scutellaris* and *Tetramorium biskrensis* in forest environments and *Tapinoma simrothi* in agricultural environments. The five study sites have good diversity in terms of species and the gathered ants seem to be subservient to each type of environment (forest or agricultural) and follow an altitudinal gradient between the various stations.

KEYWORDS: Formicidae, Inventory, Tizi-Ouzou, Species Richness, Area

INTRODUCTION

Ants are among the most common and are found in most terrestrial insects (PASS & Aron, 2005). Their global biomass even exceed that of humans (Hölldobler & Wilson, 1996; PASS & Aron, 2005). With over 12,500 species described to date (AGOSTI & Johnson, 2005), this group of insects is of great interest as an indicator of biodiversity (ALONSO, 2000). In addition, the ants are the main predators of arthropods and in some cases the main predators of herbivores. They also change their physical environment through their excavation activities that can rival those of earthworms. The accumulation of organic matter in or around the colonies contributes further to the soil enrichment, namely with nitrogen and phosphorus, elements which are essential to the growth of many plants (BEATTIE, 1985; BEATTIE & Hughes, 2002).

In Algeria, despite the importance of these insects, few studies have been conducted on their diversity and distribution. Indeed, to date, the systematic Algerian myrmecofauna seems to be known only through the work of Bernard (1951-1983) and those of Cagniant (1966-2005). Works of ant populations listing and the study of aspects of their routine will allow for the updating of knowledge and the determination of the importance of these insects in ecological studies. It is in this context that the present work, which consists of an inventory of the ant fauna in some forest and agricultural areas of Kabylia, is alligned to better know composition and distribution of harvested species.

Study Areas

We conducted this study in different environments of Kabylia (in the wilaya of Tizi-Ouzou, distant one hundred km from Algiers) at different altitudes (Figure 1).

- The station Ighil M'heni of Aghribs region located 300 m above sea level and 40 km northeast of Tizi-Ouzou,

- Azazga station is 500 meters above sea level and about forty miles east of Tizi Ouzou,
- Tazerouts station in the region of Ain El Hammam (AEH) at 1200 m above sea level and about 45 km east-southeast of Tizi Ouzou city.
- A citrus grove and orchard peach in Oued Aissi, region situated in Tizi Ouzou located 200 m above sea level.

METHODOLOGY

In this study, the sampling method used in the field is that of traps or barber pots. According to Chazeau et *al.* (2004), barber traps give a fairly good picture of ant communities. They are indicativors of the density-activity of invertebrates moving at the soil surface and allowing comparison of populations between areas (faunal composition, diversity, dominant species).

This method involves the use of tin cans with a volume of liter. The material is buried vertically so that the opening is at ground level. The dishes are placed according to the method of the transect which consists of a line indicated by a string along which traps are placed. Ten pots are placed online equivalent to a trap every five meters. Filling the traps is done to 1/3 of their content by adding a detergent to facilitate attachment of the insects. The contents of the boxes were recovered after 48 hours.

In the laboratory, we proceeded to sample sorting, separating individuals of different caught species. Then, we proceeded to the identification of the different caught species and the calculation of the number of individuals for each species.

To exploit the results obtained in this study, different ecological indices are calculated for all species inventoried. The calculated composition indices are the average wealth (S), relative abundance or centesimal frequency, the frequency of occurrence or constancy, the Shannon-Weaver diversity index and equitibleness.

Data Analysis

To highlight the probable existence of a link between the characters, we applied the Chi square test (X2). To describe the dependence or correspondence between two sets of characters, we applied a correspondence analysis (PCA).

RESULTS

Subfamilies Inventoried

The examination of 450 samples in this study identified three subfamilies: Myrmicinae the Formicinae and Dolichoderinae. The analysis of the proportion of subfamilies shows a preponderance of Myrmicinae with 57% of actual captures and a relative balance of Formicinae and Dolichoderinae subfamilies (Figure 2). Noticeably, this balance shows that the sampling was complete, the Dolichoderinae are predominantly arboreal ants and Formicinae are mainly ground-dwelling ants.

Proportion of Subfamilies at Each Station

The distribution of subfamilies among the various stations is different. The Myrmicinae dominate all areas and represent over 50% of the gathered ant fauna. It is followed by the subfamily Formicinae in Ighil M'heni, Azazga and Tazerouts stations that represent forest environments. Dolichoderinae mostly present on the edges and in open areas, are largely collected in agricultural areas (orchard 1 and orchard 2) and they are poorly present in the forest (Figure 3).

Ant Species Inventoried in the Different Study Sites

We surveyed 15 species of ants which 7 of them belong to the Myrmicinae subfamily, 6 to the Formicinae subfamily and 2 to the Dolichoderinae subfamily. Some species appear to be characteristic of a station or medium. Thus, the species *Crematogaster scutellaris* subservient to the oak was encountered in forest environments, *Tapinoma simrothi* is only recovered in the orchards. *Camponotus cruentatus* is solely present in high altitude in Tazerouts station and *Cardiocondyla sp*. is harvested in the Ighil M'heni station.

Six species (*Catglyphis bicolor, Aphaenogaster testaceo-pilosa, Pheidole pallidula, Tetramorium biskrensis, Tapinoma nigerrimum and Messor barbara*) are present in the all surveyed areas (Table 1)

Structure and Composition of the Population of Ants

Among the 15 species caught in the different environments, 13 species were gathered in Ighil M'heni station making it the richest station, 11 species have been harvested in Azazga, 8 inTazerouts and 10 in both orchards of Oued Aissi.

In Ighil M'heni station, which contains a total of 13 species, *Crematogaster scutellaris* is the most abundant (Figure 4) with a percentage of 24.36%. The species *Monomorium Salomonis* and *Cardiocondyla sp*. are relict and represent respectively only 0.43% and 0.05% of the total ant fauna of the station.

Of the 11 species found at Azazga, *Crematogaster scutellaris* predominates with 33.30% of the stand (Figure 5). The species *Monomorium salomonis* and *Paratrechina longicornis* represent the very low rates of 0.66% and 0.58% respectively.

The 8 species recorded in Tazerouts present differences in abundance. Both *Pheidole palidulla* and *Aphaenogaster testaceo-pilosa* species predominate with the respective percentages of 25.91% and 24.54% (Figure 6). *Tetramorium biskrensis* is poorly represented with only 2.77%.

In agricultural environments (orchard 1 and orchard 2), *Tapinoma simrothi* is the most abundant specie with a rate of 32.24% in the orchard 1 and 30.39% in the orchard 2 (Figures 7 and 8).

The application of the concept of occurrence or consistency on ants collected in the three stations helped to define five categories (Table 2). Thus, at the level of Ighil M'heni station, 4 categories of occurrence were recorded. The "constant" category is represented by *Aphaenogaster testaceo-pilosa* specie. The species *C. scutellaris, C. barbarus xanthomelas, P. palidulla, T. biskrensis, T. nigerrimum, P. schmitzi* and *M. barbara* are termed "regular ", and *C. bicolor, P. barbara* and *P. longicornis* are termed " accessories ". Finally, *M. salomonis* and *Cardiocondyla sp.* belong to the category of "rare" species.

Five categories of occurrences were defined at Azazga: *C. scutellaris* is "constant", *C. bicolor, A. testaceo- pilosa* and *C. barbarus xanthomelas* are "rare". *P. palidulla, T. nigerrimum, P. schmitzi* and *M. barbara* are "accessories". *T. Biskrensis, P. barbara* and *P. longicornis* are "accidental" and *M. salomonis* is "rare".

At the level of Tazerouts station, the "constant" category includes *A. testaceo-pilosa* and *C. cruentatus*, and the "Regular" category includes *C. scutellaris, P. palidulla* and *M. barbara*. The "accessory" category is represented by *T.biskrensis* and *T. nigerrimum*.

The citrus orchard represents only 3 constant categories: *T. simrothi* and *A. testaceo-pilosa* are "constants". *P. palidulla* and *M. barbara* are "regular". *C.barbarus xanthomelas*, *T. biskrensis*, *T. nigerrimum*, *P. barbara* and *P. longicornis* are "accessories".

It is the same for the peach orchard, where three categories of occurrences were identified. The species *T. simrothi*, *A.testaceo-pilosa* and *P.palidulla* are "constants". *C. barbarus xanthomelas*, *T.biskrensis*, *P.barbara* and *M.barbara* are "regular", *T. nigerrimun* and *P. longicornis* are "accessories":.

The diversity index of Shannon-Weaver calculated for the Formicidae species provide the values of 0.88 bits for Ighil M'heni station, 0.79 bits for Azazga station, 0.76 bits for Tazerouts station and 0.86 bits for Oued Aissi orchards. These values are consistent with good diversity and strong activity of ant populations in these environments, the most diverse station is the station of Ighil M'heni. Furthermore, equitability index reveals the values of 0.73 in the first station, 0.73 in the second, 0.84 for the third and for the last 0.86, indicating a good distribution of ant's populations in the different prospected environments.

The Chi square statistical test applied to ant numbers identified in forest environments, staffing harvested in the farming community and the total numbers identified in all stations has led to the same conclusion of significant dependence on threshold $\alpha = 0, 05$. This dependence is that between the presence of ant species in a medium and the medium itself. So there is a significant dependency between the ant fauna inventoried and different stations we sampled ($X2 = 11,627.52$ at all stations, $X2 = 3317.89$ in forest environments and $X2 = 32.79$ in agricultural environments).

We associated with altitudinal parameter, the type parameter of environment (forest or agricultural) in the representation of data on ants counted at our study, a matrix with 5 stations and 15 species expressed in the factorial design of F1xF2 AFC that holds 93% of the information (Figure 9). The plan review 1 x 2 (Figure 9) discriminates ant species into 4 groups which are:

Group 1 contains the species dependent on medium-altitude resorts in forest environments: Ighil M'heni (300 m) and Azazga (500 m). They are *C. scutellaris*, *C. barbaricus xantomelas*, *P. schmitzi*, *T. nigerrimun*, *M. salomonis* and *Cardiocondyla sp.*

Group 2 represents the characteristic species of agricultural environments. This is *T. simrothi* and *T. biskrensis.*

Group 3 in which we find medium altitude species in both forests and agricultural environments. They are *P. barbara*, *C. barbaricus xantomelas* and *P. longicornis*.

Group 4 contains altitude species, but belonging to the two types of environments (forest or agricultural). These species are *M. barbara*, *P. palidulla* and *A. testaceo-pilosa.* This core also contains the specie *C. cruentatus* which is alticole and only found in the Tazerouts station (1200 m).

DISCUSSIONS

The average wealth of Formicidae of the wilaya of Tizi-Ouzou identified in the different study sites is 15 species. It appears that in all of these environments, the species *C. barbaricus xantomelas* appears as an abundant species in the stations Azazga and Tazerouts and poorly represented in the other stations. *T. simrothi* is absent in forest environments and abundant see swarming in orchards.Moreover, *A. testaceo-pilosa* is moderately abundant in all stations. Cagniant (1973) believes that it is indifferent towardsthe canopy, so it does not seem to be favorable and suitable media for this specie.

On the other hand, *C. scutellaris* were encountered only in forest environments. This result joins those of Cagniant (2005) according to which *Crematogaster* is one of the richest genus on forest species. He also showed that the species that compose it generally form populous societies, often tree or soil dwelling.

The ant *M. barbara* is present in all stations and does not seem to have clean environment. Detrain et *al.* (1999) report that for this major predator of grasses in annual grasslands of the Mediterranean area, the distribution and the maximum density is a function of the natural conditions of seeding and meet the requirement of the optimal harvest theory.

C. bicolor was encountered, in the course of our study, in all stations. Cagniant (2009) reports that *Cataglyphis* is found in North Africa from the sea up to 2800 m in the Hoggar (case of targuia shape) and seems to nest in open areas.

Furthermore, we found that the species *T. simrothi* is constant in citrus orchard. In all sampled stations along this study, besides the high diversity, a good distribution of ant populations in the different surveyed environments is observed. in the same way, a significant dependence between the different environments and the inventoried species was showed. Similarly, this trend by Formicidae to follow a gradient in their distribution was also observed by Delsinne (2007) in his study on the structure of ant assemblages along an aridity gradient.

What emerges from this study, is that the distribution of Formicidae key parameters are altitude and the type of medium (forest or agricultural). *C. bicolor*, very common in all types of environments, does not belong to any group and *C. barbaricus xantomelas* common to both groups, has a wide ecological valence and adapts to all types of environments.

Interactions between plants and ants are extremely varied and likely reflect closely related evolutionary histories. It seems that the diversification of angiosperms could directly influence the ants from -100 -60 Ma, particularly through the development of new food resources for these last (herbivorous prey trophobionts or vegetable substances) (Wilson and Hölldobler 2005; Moreau et *al.*, 2006).

CONCLUSIONS

It seems that the main factors determining the distribution of the Formicidae are altitude and type of environment.

Through the results obtained in this study, we were able to report that the inventoried areas have good species diversity and good spatial distribution of different species. It has been shown that *C. scutellaris* and *P. pallidula* predominate in forest areas and *T. simrothi* in agricultural ones. It is clear that ants have a great capacity for adaptation in forest environments as in agricultural environments despite the conditions that can be difficult.

After this study, we suggest to complete this work by conducting sampling in other types of environments and increase the number of surveys and direct observation in order to have more information on the composition of the ant fauna of Algeria and the biology of species in their natural environment.

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APPENDICES

Table 1: Ant Species Inventoried in the Various Stations

Sous-Familles	Les espèces de fourmis inventoriées	Station			
		Ighil M'Heni	Azazga	Tazerouts	Vergers 1 et 2
Formicinae	*Catglyphis bicolor* (Fabricius, 1793)	+	+	+	+
	Camponotus barbarus xanthomelas (Emery, 1905)	+	+	-	+
	Plagiolepis schmitzi (Forel, 1895)	+	+	-	-
	Plagiolepis barbara	+	+	-	+
	Paratrechina longicornis (Latreille, 1802)	-	+	-	+
	Camponotus cruentatus (Latreille, 1802		-	+	-
Myrmicinae	*Crematogaster scutellaris* (Olivier, 1792)	+	+	+	-
	Aphaenogastertestaceo-pilosa (Lucas, 1849)	+	+	+	+
	Tetramorium biskrensis (Forel, 1904)	+	+	+	+
	Pheidole palidulla (Nylander, 1848)	+	+	+	+
	Messor barbara (Linné, 1767)	+	+	+	+
	Monomorium salomonis (Linné, 1758)	+	-	-	-

	Cardiocondyla sp. (Emery, 1869)	+	-	-	-
Dolichoderinae	*Tapinoma nigerrimum* (Nylander, 1856) *Tapinoma simrothi* (Krausse, 1911)	+ -	+ -	+ -	+ +

(+): Presence (-): No

Table 2: Constance Applied to the Ant Fauna Inventoried in the Five Study Sites

Stations	Ighil M'heni (300 m)		Azazga (500 m)		Tazerouts (1200 m)		Verger 1 (200 m)		Verger 2 (200 m)	
Espèces	**C%**	**Cat.**	**C%**	**Cat.**	**C%**	**Cat.**	**C%**	**Cat.**	**C%**	**Cat.**
Catglyphis bicolor	37,78	**A**	72,85	**R**	51,42	**R**	62,22	**R**	80	**C**
Crematogaster scutellaris	57,78	**R**	91,43	**C**	70	**R**	-	-	-	-
Aphaenogaster testaceo-pilosa	82,22	**C**	50	**R**	75,71	**C**	84,44	**C**	76,67	**C**
Camponotus barbarus xanthomelas	68,88	**R**	77,14	**R**	-	-	46,67	**A**	52,22	**R**
Camponotus cruentatus	-	-	-	-	78,57	**C**	-	-	-	-
Pheidole palidulla	72,22	**R**	48,57	**A**	50	**R**	64,44	**R**	75,55	**C**
Tetramorium biskrensis	58,88	**R**	20	**Ac**	47,14	**A**	48,88	**A**	57,78	**R**
Tapinoma nigerrimum	65,55	**R**	30	**A**	37,14	**A**	30	**A**	36,67	**A**
Tapinoma simrothi	-	-	-	-	-	-	86,66	**C**	91,11	**C**
Plagiolepis schmitzi	65,55	**R**	37,14	**A**	-	-	-	-	-	-
Plagiolepis barbara	38,88	**A**	8,57	**Ac**	-	-	40	**A**	52,22	**R**
Paratrechina longicornis	36,66	**A**	5,71	**Ac**	-	-	35,55	**A**	38,88	**A**
Messor barbara	50	**R**	27,14	**A**	68,57	**R**	53,33	**R**	51,11	**R**
Monomorium salomonis	3,33	**r**	2,86	**r**	-	-	-	-	-	-
Cardiocondyla sp.	1,11	**r**	-	-	-	-	-	-	-	-

C%: constancy, Cat. : Category C: constant, R: Regular, A: accessory, Ac: accidental, r: rare.

Figure 1: Geographical Location of the Various Study Sites in the Wilaya of Tizi Ouzou

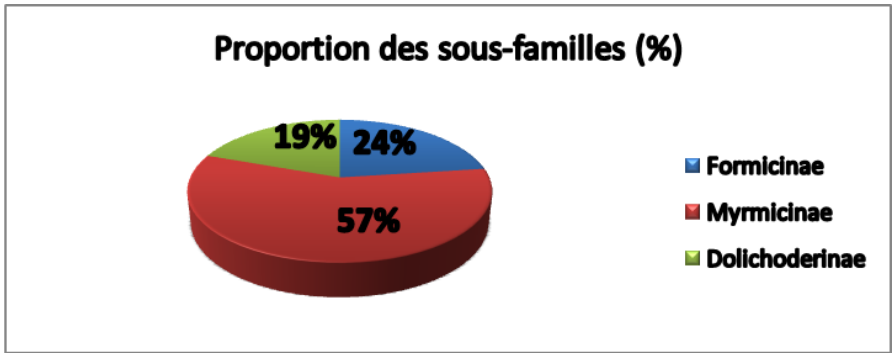

Figure 2: Proportion of Subfamilies Identified In the Five Study Sites

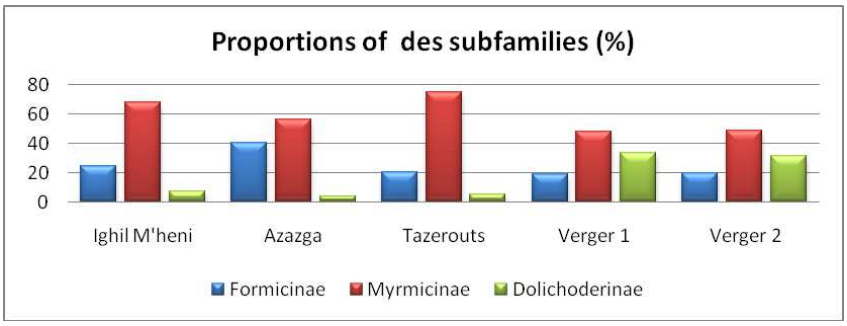

Figure 3: Proportions of Subfamilies at Each Station

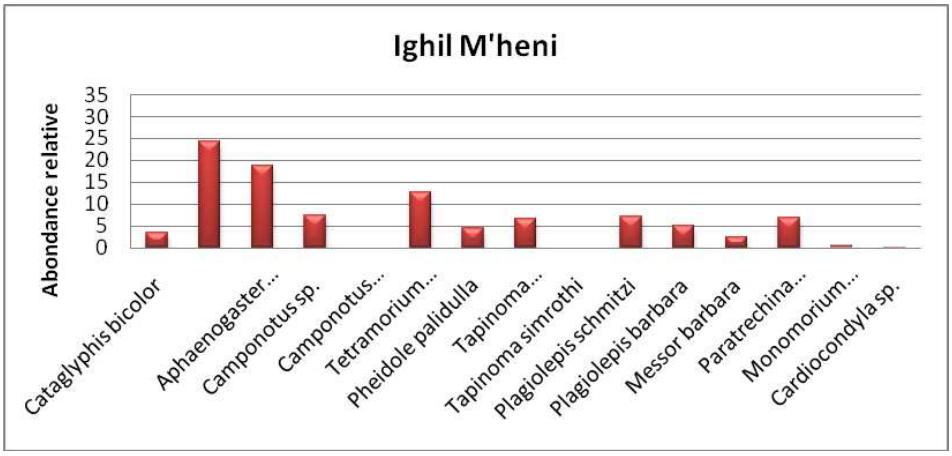

Figure 4: Relative Abundance of Different Species in the Ighil M'heni Station

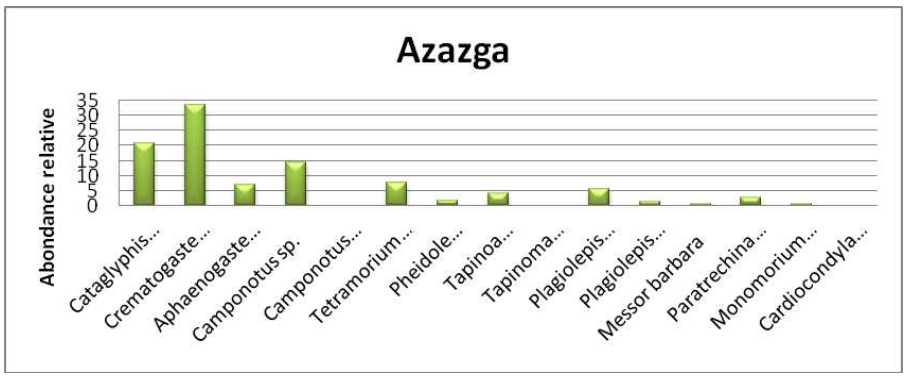

Figure 5: Relative Abundance of Different Species in the Azazga Station

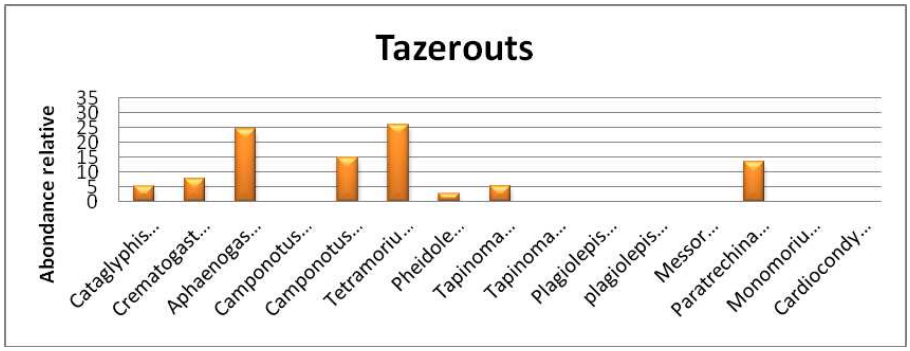

Figure 6: Relative Abundance of Different Species in the Tazerouts Station

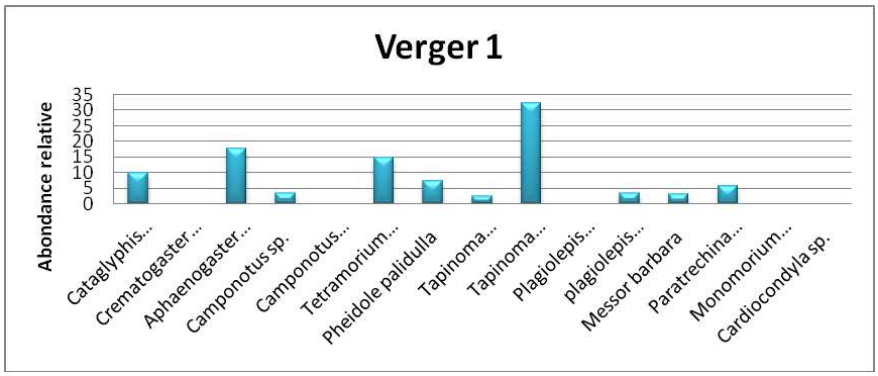

Figure 7: Relative Abundance of Different Species in the Orchard 1.

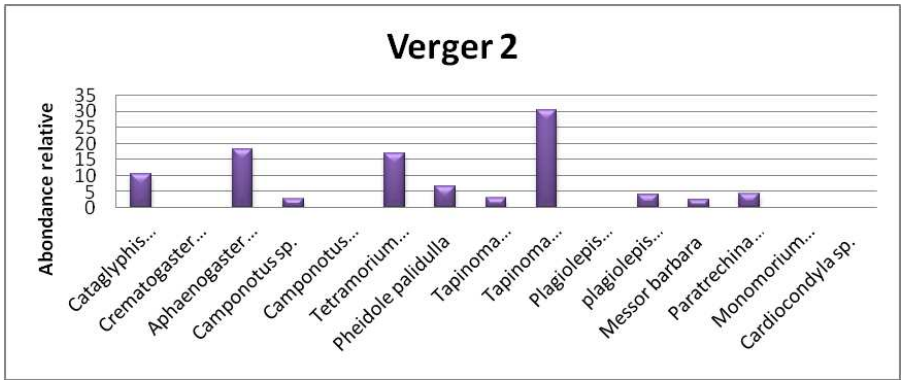

Figure 8: Relative Abundance of Different Species in the Orchard 2

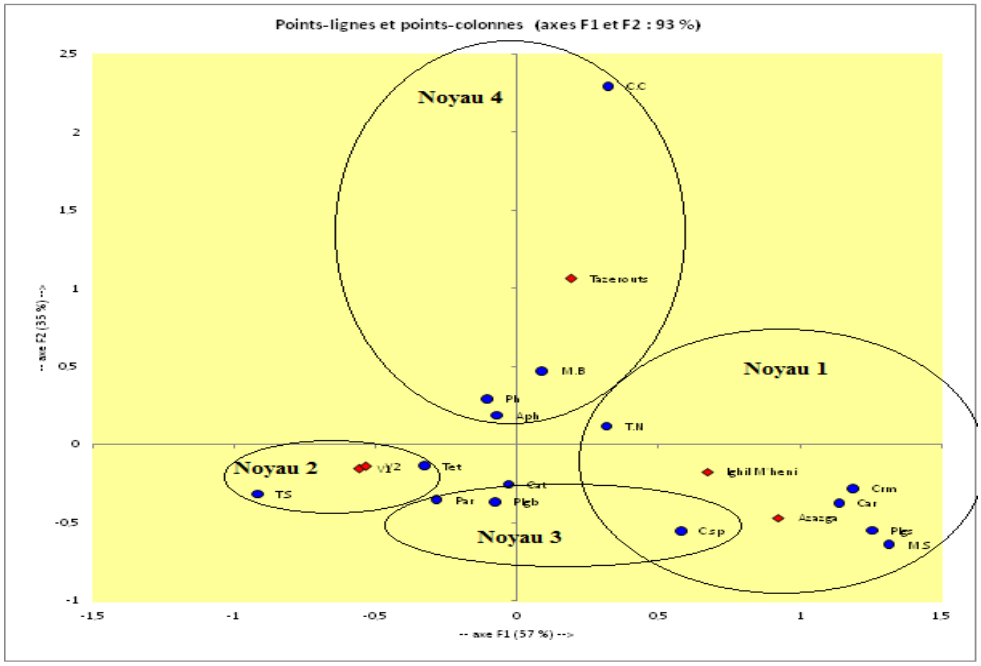

Figure 9: Projection of Ant Species and Parameters Studied in the F1 x F2 Plan